

Sociodemographics and Small Businesses: Benchmarking Historical Participation Patterns across SBDI Programs

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ABSTRACT

Small business energy efficiency (EE) programs allow utilities to deliver cost-effective savings and engage so-called “hard-to-reach” commercial customers with value propositions that contribute to environmental sustainability. Often delivered through contractor networks, small business direct install (SBDI) programs also support local economies through workforce education and development of both local business owners and contractors. As demand-side management (DSM) programs mature, utilities and program administrators must develop data-driven engagement strategies based upon in-depth analyses of past participation trends, current savings opportunities, and sociodemographic indicators to drive program awareness and participation. Benchmarking community-level details of small business participation patterns using a sociodemographic lens offers a powerful tool for proactively identifying and targeting underserved groups and defining what exactly is “hard-to-reach” within the small business customer segment.

This paper presents preliminary results from a deep-dive analysis of participation patterns across multiple SBDI programs over a five-year period. We describe the extract, transform, and load (ETL) process used to create a standardized data schema consisting of historical SBDI program tracking; billing data for SBDI-eligible customers; and sociodemographic data at the ZIP code-level of geographic granularity. We present key findings on the spatial variation of cross-program SBDI program delivery—including participants and non-participants—along key sociodemographic indicators of urbanity, linguistically-diverse communities, and community-level poverty. Finally, we discuss how this type of replicable, empirical analytics helps inform real-time, data-driven strategies for program design and delivery for SBDI programs and utility DSM programs in general.

Introduction

Importance of Small Businesses to Energy Efficiency Programs

Small commercial buildings of fewer than 50,000 square feet are approximately 44% of total commercial energy use, 51% of total floor space, and 95% of total facilities in the United States (DOE 2013). Within these small commercial facilities, the US Department of Energy (DOE) estimates that approximately 75% are less than 10,000 square feet. At the same time, these customers can account for anywhere from 50% to over 90% of the total facilities in a commercial and industrial (C&I) portfolio, depending on the utility and their eligibility for programs target to small businesses. These customers fall into the category of unmanaged accounts for utilities; the sheer number of small businesses and relatively smaller size of their facilities presents a unique set of opportunities and challenges for demand-side management (DSM) program managers and implementation contractors.

SBDI program tracks were created to address barriers to participation in energy efficiency programs from the small business sector. The common barriers to participation in

SBDI are lack of financial resources for investment in energy equipment, low technical knowledge, and lack of time to dedicate to energy matters. These are real and constant challenges faced by SBDI program designers, managers and implementers, as well as the small businesses themselves. SBDI program eligibility is typically based on a rate schedule (i.e., “small commercial”) and a kW demand threshold or annual kWh consumption threshold. The contractor-driven model of direct install programs allows for vetted trade allies¹ to engage SBDI customers with value propositions designed for quick proposal generation and project execution with considerably higher buy-downs than large business incentive programs.

Lack of Detailed Empirical Analysis on SBDI Program Delivery

Historically, SBDI programs have relied on low-hanging fruit picked by program trade allies to deliver energy savings to what is still often considered a hard-to-reach or underserved subset of a utility’s nonresidential portfolio. As such, SBDI programs have been successful at expanding the depth and breadth of EE/DSM savings delivery and customer engagement efforts. Yet, the fast-paced and ever-evolving world of energy efficiency begs for a deeper understanding of what exactly is “hard-to-reach” *within* the small business customer subset. As discussed above, the hard-to-reach category of small business customers is usually based upon energy usage and demand thresholds, which do not account for the location of businesses or other attributes of their surrounding communities like income and linguistic diversity. In many rural areas, for example, there is often limited access to trade allies to install projects. For trade allies, the value proposition to deliver small business EE projects can be much less attractive than in dense areas. This type of in-depth understanding of the value propositions for customers and trade allies is becoming increasingly necessary in the DSM marketplace, with often competing claims and methodologies around identifying and targeting opportunities.

Achieving a comprehensive understanding of SBDI program trends can be daunting, as program tracking data is often difficult to obtain and provided in formats that are challenging to overlay with additional data like energy use, location, and sociodemographics. While recent efforts like the DOE Building Energy Data Exchange Specification (BEDES) data dictionary have made great strides in helping create a harmonious and public taxonomy of building energy use and DSM program data, DSM program designers and implementers still rely on custom data tools to understand and interpret past participation patterns.

Moving Forward to Minimize Program Risk and Deliver Savings

DNV GL has been implementing SBDI programs on behalf of utilities across the United States since 2002. Our thorough knowledge of SBDI measure design, contractor certification and management, and savings realization rates allows us to continually refine best practices in program implementation and evaluation. To inform program planning and consistently enhance program data quality, DNV GL maintains a central tracking database that maps EE program tracking data for individual program validation and cross-program comparisons (St. John et al 2014).² DNV GL also has significant experience in creating robust customer profiles for residential and nonresidential programs that combine often disparate sets of customer billing

¹ Trade allies are industry professionals that provide lighting, HVAC, refrigeration and other installation services for energy efficiency projects.

² St. John et al (2014) used DNV GL’s central tracking database to analyze energy efficiency measure cost over time and across regions.

data, program tracking data, GIS and spatial data, and US Census data to collect and clean data for reliable and accurate analyses (Crowley et al 2016; DNV GL 2015).

This paper presents preliminary findings from a cross-program, deep-dive historical analysis into sociodemographic variation program delivery metrics by mining five years of data across four SBDI programs. By examining and presenting sociodemographic insights on program delivery, we hope to add a data-driven, empirical perspective on how to design and implement SBDI programs that proactively create customer engagement opportunities and deliver energy savings while remaining transparent and cost-effective.

Methodology

This sociodemographic analysis of SBDI participation trends relies on a triangulation of three general types of data that are usually collected for different business or social uses and hence can be in very different formats:

- SBDI program tracking (or participation) data collected from DNV GL’s central tracking database, which we used to examine the variation in key performance indicators of DSM programs, such as cost per kWh saved
- Billing data for SBDI-eligible premises and accounts, including ZIP-level aggregations of premise counts and total kWh consumption, which we used to produce aggregate totals for kWh consumption and distinct count of eligible premises
- Sociodemographic data from the US Census Bureau, which we used to create community-level variables for urbanity (premise density), areas of limited English language proficiency and areas with a high concentration of poverty

ETL Process: Translating Data to Strategy

This analysis uses a standardized data schema that combines all of our key data points across multiple sources, programs and formats using an extract transform and load (ETL) process. This ETL process is dynamic and allows us to refresh program tracking results to keep up with the fast-paced world of energy efficiency program delivery.³ The overall approach for this ETL process is as follows:

- Data are queried from multiple databases for each specific source type of data needed: program tracking data, customer billing data and sociodemographic data (extract)
- Data extracts are standardized into a consistent format (transform)
- Standardized data are accurately and efficiently stacked for analysis at the ZIP-code level of granularity (load)

Since this particular analysis explores spatial variation in program participation along community-level sociodemographic indicators, this ETL process uses the ZIP code as a standardized level of spatial granularity. Most SBDI program participation and billing datasets contain ZIP-code level data that are often outdated and prone to quality issues like data entry

³ Program data are often updated weekly, if not daily, depending on specific business and reporting needs. This means that data stored only in spreadsheets can become obsolete even before a basic analysis task is finished.

errors. By using an address locator we were able enhance the accuracy to the spatial mapping of our participant and billing file using a custom-built geocoder in ArcGIS (Crowley et al 2016; Crowley and Brougher 2014; DNV GL 2015). A further level of quality control was applied when aligning the participation and billing data with sociodemographic data from the Census Bureau.⁴

Metrics for Benchmarking & Program Strategy

With a dynamic ETL process in place we then explored the spatial variation of our sociodemographic factors along key metrics of program delivery. The program metrics presented in this analysis include:

- Savings delivery cost: SBDI incentive cost per kWh of savings
- Savings intensity factor: average annual kWh savings (2010-15) relative to annual kWh consumption (2015). Savings intensity factors can be inflated by large consumers undertaking a small number of projects that reap large kWh savings. Since we have limited this analysis to SBDI-eligible premises where end-users consume smaller amounts of kWh,⁵ we have attenuated the inflation often seen in this metric.

Primary Analysis and Results

In this section we explore the variation in these program metrics across sociodemographic factors of small business density, community-level linguistic diversity, and community-level poverty.

Density of Eligible Small Businesses: An Urban/Rural Gradient

Understanding the density of eligible SBDI customers in a given service territory is crucial to program design and delivery. Even among SBDI programs that do not have any specific carrot to stimulate geographic reach, most program managers and administrators want to ensure a modicum of parity among the geographic delivery of EE programs, and trade allies want to know where clusters of eligible businesses are located. This is especially true in SBDI programs where the denser or more clustered areas have had historically higher levels of program participation.

We examined the density of SBDI-eligible premises across programs using a standardized metric: count of unique SBDI-eligible premises per square mile.⁶ We then created bins or groupings based upon the density of small business per square mile to facilitate comparisons. SBDI-eligible premise density calculation is based upon ZIP-level data. Table 1 shows an overview of the premise density groups and each group's share of ZIP codes percent of

⁴ The Census Bureau uses the zip-code tabulated area or ZCTAs to “crosswalk” postal zip codes that may change over time into consistent areas for collecting and reporting sociodemographic data.

⁵ The threshold for SBDI-eligibility is approximately 400,000 annual kWh in the most aggressive instances.

⁶ This analysis uses premise as the most granular level of detail in a utility billing dataset. Some utilities treat each meter as a premise, group individual meters within a premise, or some combination of both. Our ETL process determined that premise is the highest level of granularity possible for cross-program analysis while maintaining accuracy across the datasets.

total kWh savings (in millions) from SBDI program from 2010-15 by each small business density bin.

Table 1. Percent of ZIP Codes, Eligible Unique Premises, Sum of Annual kWh Consumption and Sum of Cumulative Program kWh Savings (2010-15) by Small Business Density Groups

Small Business Density: Percentages Across SBDI Programs Analyzed				
<i>Small Business Density Groups</i>	Total ZIPs	Number of Unique Small Business Premises	Sum of Annual SBDI-Eligible kWh Consumption	Sum of SBDI kWh Savings (2010-2015)
<2 SB/sq mi	38.56%	8.54%	7.67%	4.98%
2-20 SB/sq mi	20.82%	16.09%	17.51%	15.71%
20-100 SB/sq mi	18.56%	24.43%	24.52%	25.53%
100-200 SB/sq mi	8.66%	15.33%	19.29%	20.85%
200+ SB/sq mi	11.96%	35.58%	30.97%	32.39%

Source: DNV GL 2016.

Approximately 32% of the total kWh savings delivered from 2010-2015 by these SBDI programs was concentrated in areas with very high small business density (≥ 200 premises/mi²), while areas of very low small business density (< 2 premises/mi²) provided approximately 5% of total kWh savings. This is not surprising as SBDI trade allies, without any particular carrot, will focus their sales efforts in more urban areas in the early phases of programs. In the very sparse areas, we see a relatively lower share of consumption, but the total kWh savings delivered over the past five years is even smaller, indicated some opportunity relative to kWh consumption. We will explore this savings intensity factor in subsequent examples.

Next we explored the variation in the cost per kWh saved across each premise density bin to give us some insight on historical SBDI delivery costs to areas with a range of densities of small businesses.

Figure 1 displays the range in program delivery cost in each small business density category. The dots are sized by the savings intensity factor. We observed the widest range in average cost/kWh in the least dense group (< 2) with a spread between \$0.09 and \$0.17 in incentive cost/kWh; we see a much tighter concentration of the program delivery cost metric in the more dense areas.

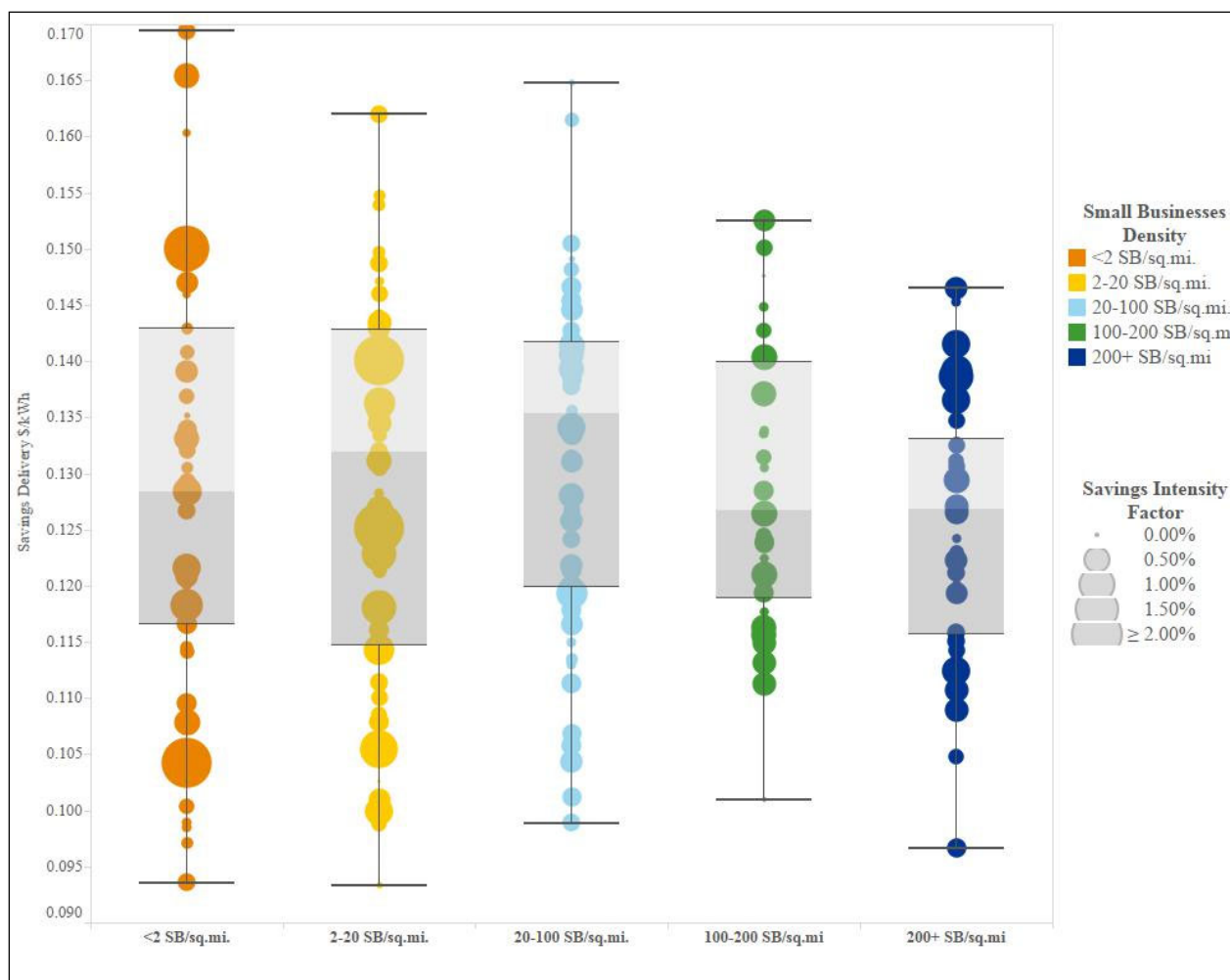


Figure 1. Savings delivery cost by small business density bins. *Source:* DNV GL 2016.

There was higher variability of program delivery costs in less dense areas. In addition, the size of the dots indicate that, within the bin of less than 2 small business per square mile, the programs achieved a high savings intensity factor at a range of program delivery costs. In fact, the average savings intensity factor is higher in less dense areas. This suggests that we have achieved similar savings intensity factor (size of dots in Figure 1) with varying rebate levels (y-axis of Figure 1).

Next we analyzed the spatial variation in the savings intensity factor across the premise density groups by creating a variable that calculates the annual kWh savings relative to consumption for small businesses within each ZIP area. Since we are exploring longer-term participation trends (i.e., not just one program year), we used the cumulative kWh savings from 2010-15 as a percentage of 2015 kWh usage to paint a broader picture of SBDI program penetration along this urban/rural gradient.⁷

⁷ Current consumption is from 2015. It is often difficult to match prior year EE project savings to current kWh consumption given mismatches between billing and project data. This analysis, however, is concerned with spatial participation patterns and thus relies on ZIP-level aggregate data.

Figure 2 show the small business density by savings intensity factor. The percent of savings to consumption was calculated at the ZIP-level to paint a picture of community-level delivery, rather than a direct match of premises. The red vertical bar represents the average savings intensity. The figure indicates that the rate of cumulative savings penetration – total kWh savings delivered as a percent of total kWh consumption – in areas of very low density (<2 premises/square mile) is two-thirds of the savings penetration rate in more dense areas. This would suggest that low density areas are not only hard-to-reach across these programs, but also present further energy-saving opportunities.

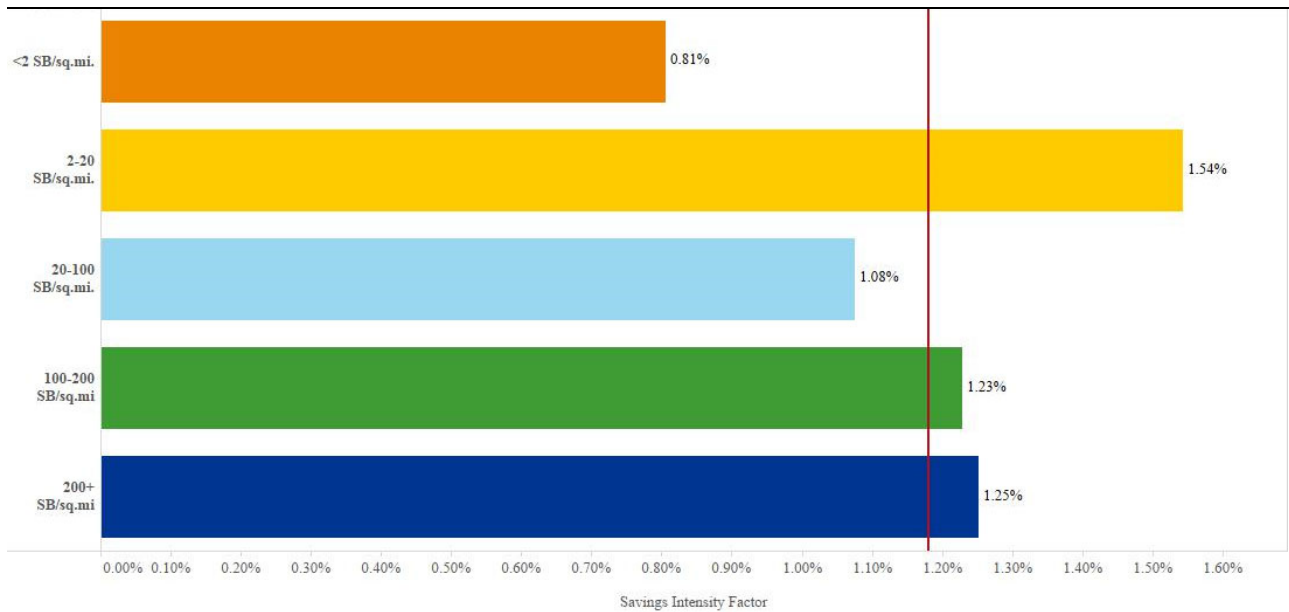


Figure 2. Small Business Density by Savings Intensity Factor. *Source:* DNV GL 2016.

Linguistically Diverse Areas

Language as a barrier to the adoption of energy-efficient technologies is well-documented in the residential sector (e.g., Murray and Mills 2011) but relatively under-researched when it comes to awareness of and participation in business energy efficiency programs like SBDI. Part of this knowledge gap can be attributed to the lack of standardized metrics for language spoken by program participants but also the general lack of data on business owner demographics. While we do not have data on the language spoken by small business owners themselves, we can gain insight from examining their local customer base.

To explore the historical participation patterns along a community-level measurement of English proficiency, we constructed a variable for linguistically isolated areas at the ZIP-code level of granularity using 2014 ACS data five-year estimates. The nationwide average for participation in limited English-speaking areas is 4.5%, and the areas that fall within the service

territories of the cross-program analysis presented here range from 0% to greater than 75% (US Census Bureau 2015).⁸

Figure 3 displays the savings intensity factor along our variable for community linguistic diversity. The red vertical bar represents the average savings intensity. This indicates that SBDI program analyzed displayed a lower savings intensity factor in areas with higher linguistic diversity. Overall, the delivery of energy savings relative to consumption – the savings intensity factor – was lower in areas of high linguistic diversity.

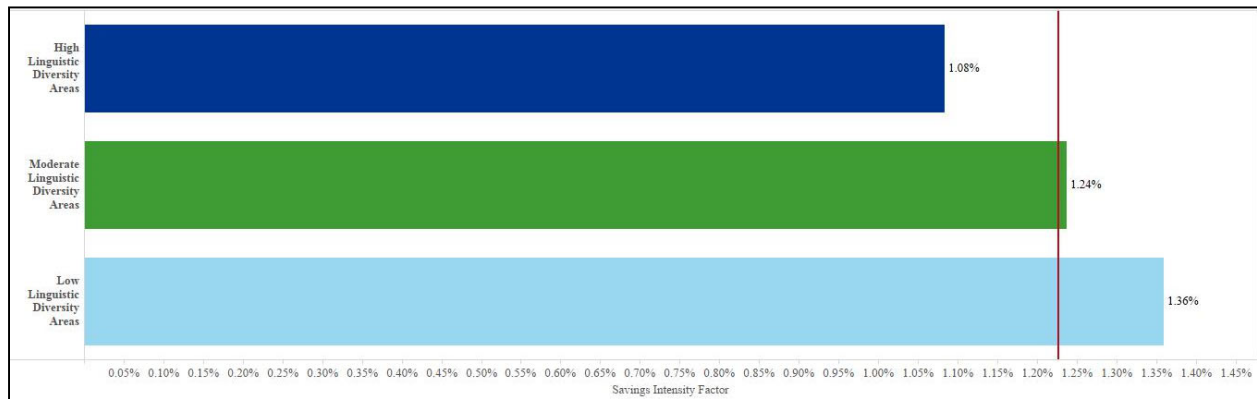


Figure 3. Linguistic diversity areas by savings intensity factor. *Source:* DNV GL 2016.

We then explored linguistic diversity coupled with small business density by ZIP. Figure 4 presents the savings intensity factor for linguistic diversity within each small business density bin. Vertical red bars represent average savings relative to consumption metric within each small business density bin. The figure emphasizes the spatial variation in our savings intensity factor with respect to linguistic diversity and density of small businesses. The red vertical line within each SB density category is the average within the subgroup.

The figure also illustrates the variability within an indicator like linguistic diversity; in very rural areas (<2 small businesses per square mile) the savings intensity factor for linguistic diverse areas was well below the average subgroup (and overall), while the very dense areas actually had savings intensity factor that was higher than the group average. This speaks to a hard-to-reach group of small businesses that are in rural areas with a high level of linguistic diversity.

⁸ The American Community Survey defines this variable as no one over age 14 speaking English proficiently or at all. Prior to the 2010 Census, this variable was referred to as “linguistic isolation” but has since been redefined as of the 2010 Decennial Census.

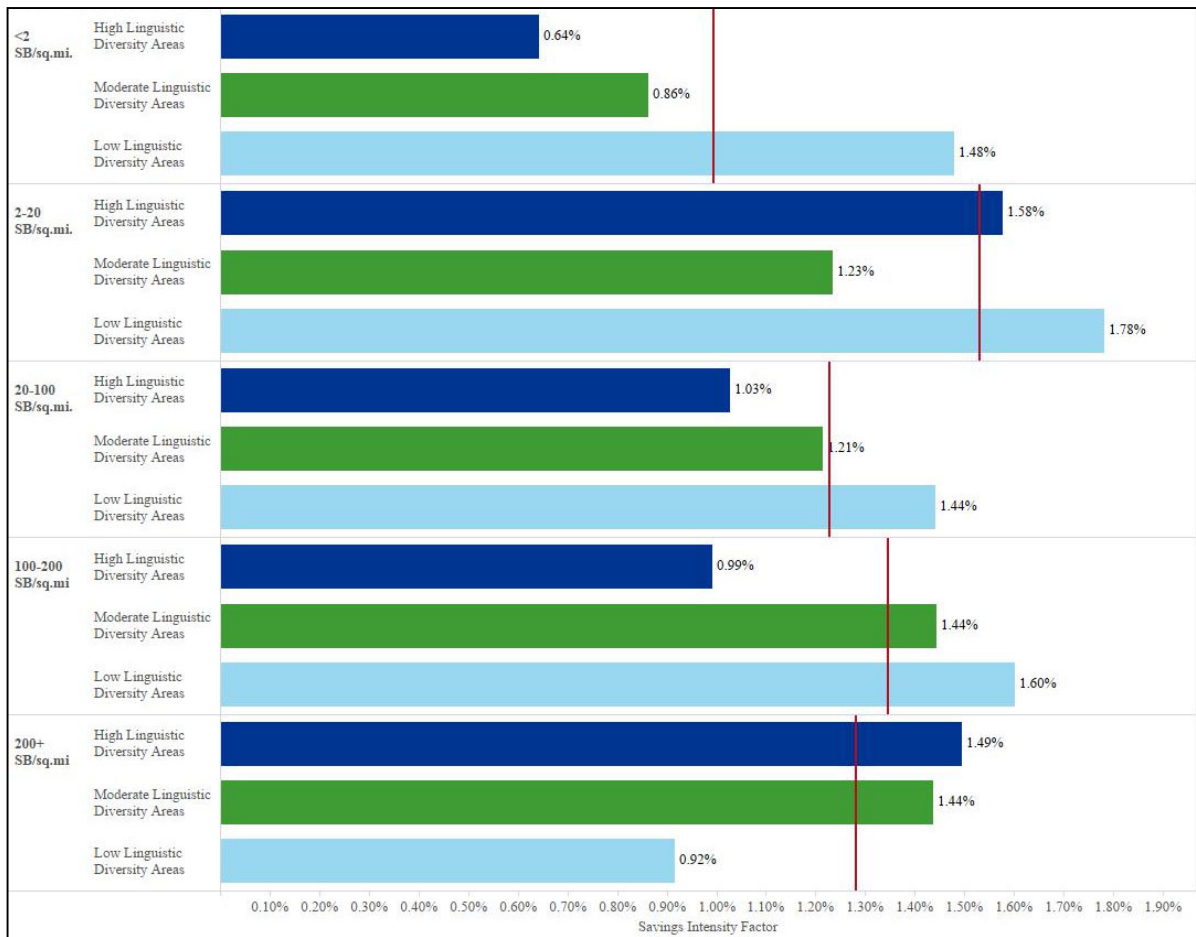


Figure 4. Linguistic diversity within small business density by savings intensity factor. *Source:* DNV GL 2016.

Impoverished Areas

SBDI programs are a community development tool for utilities to positively engage customers with wealth-creating value propositions. Compared to larger commercial establishments, many small businesses are fixtures in their communities as their clientele are local residents, shoppers, users of professional services and supporters of non-profits and faith-based establishments. In this analysis we use household income as a proxy for community-level poverty and calculated a poverty variable based upon the percentage of households at or below the federal poverty threshold.⁹

We constructed a poverty variable based on the percentage of households in a ZIP-code tabulated area with less than \$35,000 in annual earnings.¹⁰ Figure 5 explores the range of income levels with our SBDI-eligible areas by displaying spatial variation in poverty by each small

⁹ Similar to our non-English speaking variable, the poverty variable relies on the 2014 US Census Bureau American Community Survey five-year estimates.

¹⁰ This definition of poverty is approximately 100% of the poverty line across the service territories analyzed here. This is a conservative estimate of poverty as many low-income energy programs based eligibility on 200% of the poverty line.

business density bin. We have also sized the dots (representing each ZIP) by the total kWh savings from 2010-15.

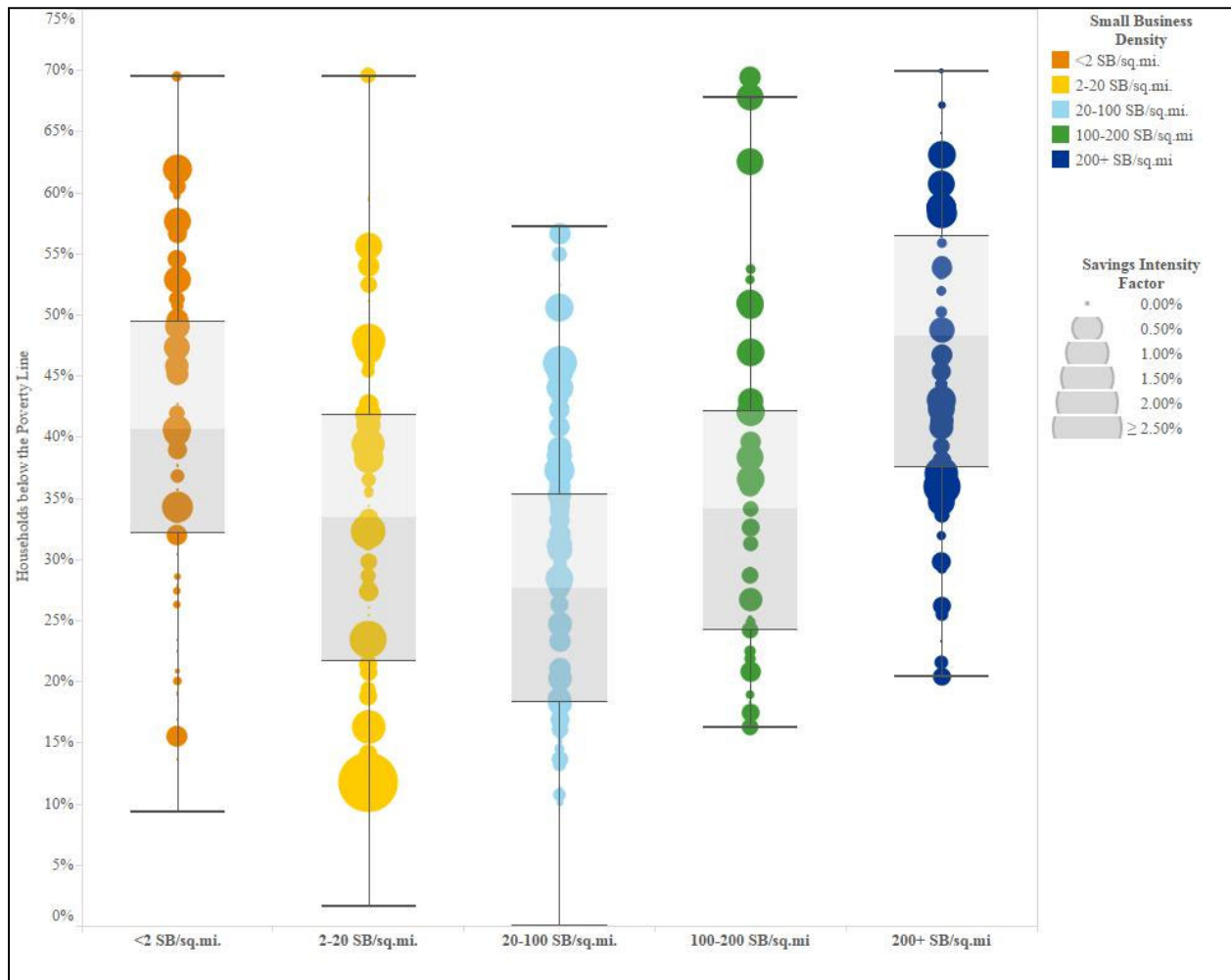


Figure 5. Community-level poverty variable by small business density groups. *Source:* DNV GL 2016.

The figure shows high levels of poverty in very sparse and very dense areas. We can also see a high savings intensity factor in areas of low poverty (e.g., the largest dot in the 2-20 small business/square-mile bin). It is challenging to draw conclusions given the variation in savings intensity across these two sociodemographic variables. There are some indicators, however, that lead us to believe that delivering higher savings intensity is much easier in areas with lower levels of poverty. This presents an opportunity to explore whether or not increasing incentives for small businesses in areas with high levels of poverty would spur stronger value propositions for small business utility customers to invest in energy efficiency.

Implications for SBDI Programs

The analysis presented is a benchmark of important sociodemographic indicators that impact program delivery and customer engagement for SBDI programs. In order to engage small

business customers, utilities must understand emerging needs. Three key takeaways from this cross-program analysis:

- Less dense areas displayed a lower savings intensity factor overall (Figure 2), but program delivery in less dense areas had been achieved with a relatively lower cost of program delivery (Figure 1).
- Areas with high linguistic diversity had a lower savings intensity factor overall, indicating opportunity for additional kWh savings delivery relative to kWh consumption for linguistically diverse areas (Figure 3).
- When we added in small business density to the linguistic diversity metric (Figure 4), we saw a stark difference in program delivery between linguistically diverse areas with very low small business density (savings intensity well below group average) and linguistically diverse areas with a very high small business density (savings intensity well above group average).

This type of analysis helps assess, define, and track data-driven strategies to increase savings delivery while minimizing impacts on program costs. Whether it is a bonus for rural areas with low density of SBDI-eligible accounts or exploring increased buy-downs for impoverished areas, benchmarking with a sociodemographic lens adds value to SBDI program analytics and helps program managers and implementers better understand community-level dynamics of DSM programs from the vantage point of these small commercial customers and trade allies that deliver projects.

Conclusion

Our analysis highlights some of the real-world tradeoffs that must be made for SBDI programs to deliver energy savings and positively impact customer satisfaction while toeing the ultimate bottom-line of cost-effectiveness. By benchmarking key sociodemographic metrics *within* the SBDI-eligible world we are able to make informed, data-driven decisions around program strategy, including limited-time offers like geographic bonuses. We look to continue to expand upon these concepts of benchmarking program delivery to positively impact program delivery and customer satisfaction, including measure-level analysis.

Value propositions for SBDI customers must be understood based upon a combination of usage, participation, and sociodemographic characteristics. For example, understanding differences between low consuming small businesses in dense, urban areas versus more rural areas can help inform program incentive structures as well as contractor training for selling energy efficiency projects. Since most SBDI programs are contractor-driven, we must also consider the value proposition for the contractors that serve small business customers. We do not want to risk SBDI contractors not being able to operate a viable business and serve specific subsets of small business customers with energy-saving engagement opportunities. If you were a lighting contractor, where would you focus your sales efforts?

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